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June, 1952 Vol. 42, No. 10

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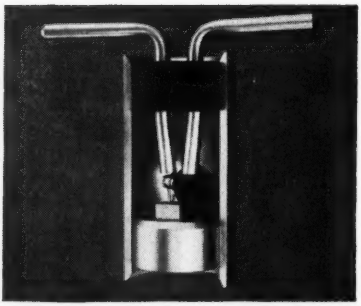
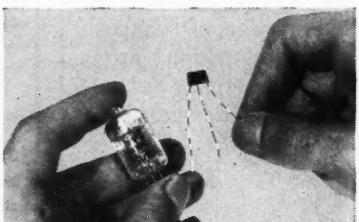
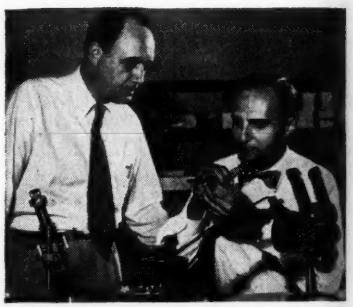


FIRST TRANSISTORS were of this point contact type (picture three times life size). Current is amplified as it flows between wires through a wafer of germanium metal. These transistors are now being made at the Allentown plant of Western Electric, manufacturing unit of the Bell System. They will be used in a new selector which finds the best routes for calls in Long Distance dialing.



NEW JUNCTION TRANSISTORS, still experimental, also use germanium but have no point contacts. Current is amplified as it flows through germanium "sandwich" —an electron-poor layer of the metal between two electron-rich ends. This new transistor runs on as little as *one-millionth* of the power of small vacuum tubes.

A picture



MUCH HAD TO BE LEARNED, especially about the surface of germanium and the effect of one part in a million of alloying materials. Transistors promise many uses—as amplifiers, oscillators, modulators . . . for Local and Long Distance switching . . . to count electrical pulses.

THE TRANSISTOR

report of progress

ASSEMBLY PROBLEMS, such as fixing hair-thin wires to barely visible germanium wafers, have been solved through new tools and mechanized techniques. Finished transistors withstand great vibration and shock. Engineers see many opportunities for these rugged devices in national defense.

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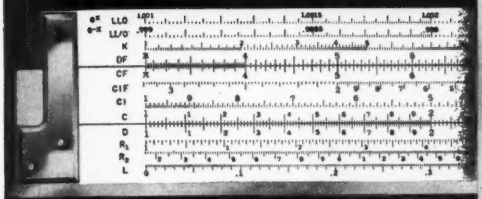

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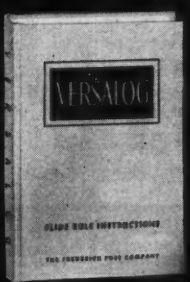

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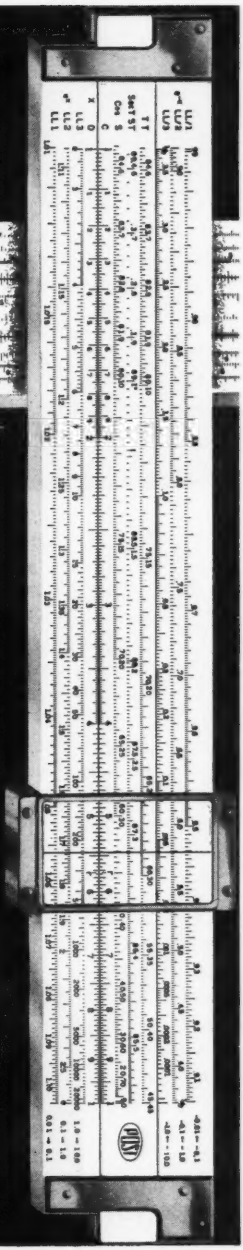

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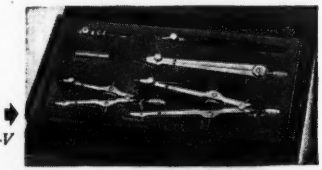

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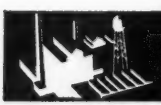

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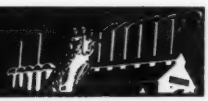

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The 1951 ASEE Engineering Education Mission to Japan

By H. L. HAZEN

Professor, Head, Department of Electrical Engineering, Massachusetts Institute of Technology

As a result of an invitation to the American Society for Engineering Education on behalf of the Supreme Commander for the Allied Powers in Tokyo, a mission of fifteen of its members spent July and August 1951 in Japan conferring with Japanese engineering educators on all phases of engineering education. Over one thousand Japanese educators and industrialists participated in the Institute for Engineering Education, which was the name of the Japanese organization for implementing the work of the Mission. Mission members returned to this country with a sense of accomplishment, of having achieved a substantial meeting of minds, and of having contributed ideas that can help Japan in solving some of her serious problems. This paper gives highlights of the Mission's work and activities, including an appendix with the essential organizational facts.

Reasons for Mission

Why send an Engineering Education Mission to Japan? Our great national interest in Japan, only recently an enemy nation, is based on our desire that she be one of the family of free nations rather than one of the slave nations. Japan occupies an important position geographically and culturally in the East. Our country has expended vast sums since the war to help Japan to become democratic in her institutions and thinking and to approach economic self-sufficiency. Educational institutions and methods of course play a dominant part in any such reconstruction; hence the significance of the several previous educational missions to Japan. The particular significance of engineering education grows out of Japan's present circumstances.

Japan has a serious basic economic problem. She is a nation of 83 million people, living in an area which is comparable with California's, and of which only 15 to 20 per cent is arable. With most intensive cultivation, this land yields only 80 per cent of her essential food. For the remainder, Japan can exchange in trade only the labor, the energy of rivers and of some coal, and the ideas that she is able to add to imported raw materials to produce exportable manufactured goods. Science and technology are thus of great importance to Japan, and this fact in turn places a large responsibility on her engineering schools. If she is to develop and produce superior products for trade, Japan needs many good engineering graduates for her industry.

Japan has over forty engineering schools, which have produced some notable men and work in past years. However, they are now suffering from poverty and from a decade or more of virtual isolation from the rest of the world. They operate with many principles and practices that we in the United States would find restraining, ineffectual, and unresponsive to the needs of engineering education as we see them. Not for many decades have they felt the influence of engineering education in the United States. Thus,

Major General W. F. Marquat was led to write to former ASEE President Thorndike Saville in part, "Preliminary discussions with other sections (of SCAP) and with Japanese educators and engineers lead us to feel that a great deal of good could be accomplished by bringing to Japan a group of American engineers who could discuss with their Japanese counterparts some of the problems which are now facing professors of engineering in Japanese educational institutions." Actually this quotation, with a few subsequent suggestions, constituted the principal instruction to the Mission.

Planning the Program

The Mission as a whole was in Japan seven weeks beginning July 6. One week was devoted to orientation and joint planning with the Japanese Executive Committee of the Institute for Engineering Education; five weeks to working sessions in Tokyo, Kyoto, Nagoya, Fukuoka, Sendai, and Sapporo; and one week in Tokyo preparing the final report, which was submitted on the morning of the day of departure, August 26.

That these seven weeks were packed with activity is indicated by the following statistics. Jointly-planned general sessions and panel discussions on the broader phases of engineering education and administration totaled 114, while 72 group conferences considered particular branches of engineering. A fruitful exchange of ideas came from 34 conferences with exclusively junior-staff and graduate-student groups. At least 1500 Japanese individuals attended one to several of these 220 meetings. Mission members gave 28 talks to professional society meetings and visited about 40 industrial plants and engineering works. Of the Mission's extracurricular activity, encouraged and implemented by SCAP as an important medium of preparation for effective work in Japanese environment, a few words appear subsequently.

That our Japanese counterparts were deeply and sincerely interested in studying and strengthening their engineering education was evident from the thoroughness and care with which they planned and executed their Institute for Engineering Education. Dr. Hiroshi Wada, Chairman of the Japanese Executive Committee, and his associates were highly and effectively co-operative from beginning to end. They accepted the proposal to use the panel and group discussion technique instead of formal lectures, although these were to them new procedures. They quickly learned to capitalize on these meeting techniques and prepared excellent and searching questions for discussion at panel and group meetings. Each meeting had a Japanese and an American co-chairman. The Mission members very soon found that real issues in educatinoal philosophy and methods became the center of attention and that the anticipated problem of establishing rapport between the oriental and the occidental mind in this field was largely nonexistent.

Language difference was of course an inconvenience, but not a real barrier. Care in screening interpretors paid high dividends, for through them was transacted most of the business of the entire Mission effort. Translation reduced the rate of expression of ideas by a factor of two or three to one. Against this, however, were the pressure and opportunity that translation time produced for sharpening up ideas and eliminating all but essential points. Also, since most Japanese participants understood some English, translation provided the emphasis of repetition. Furthermore, ideas seldom can be absorbed as rapidly as they can be expressed in a single language; hence, the loss in pace was probably more apparent than real in terms of significant ideas exchanged.

The real work of the Mission proved to be the conduct, jointly with the Japanese, of an extended series of symposia covering the broad subject of engineering schools and education. American ideas were emphasized as the Japanese were in general unfamiliar with these and wanted

to learn about them. The results of the Mission thus consist basically of new ideas and stimulus in the minds of men and are not susceptible of easy statement and demonstration. However, the scope of our discussions is sketched subsequently. One tangible result is the initial steps that are being taken toward the formation of a Japanese counterpart of our ASEE. Our fellow ASEE members are of course interested in engineering education in Japan. While critical examination and appraisal were not our main object, certain definite impressions were formed as follows.

Engineering Education in Japan

National universities, in general the most important, are closely controlled in budget, personnel appointments, and operations by the central government, severely restricting the autonomy and flexibility of operation of the individual university by our standards. Administrative posts are largely limited-term elective in character. Funds may be used only in accord with detailed original budget allocations. Virtual prohibition of personal income from consulting by faculty in government institutions greatly hinders industry-university relations, as does the strong emphasis on patents and trade secrets. Some research institutes, separate from but close to universities, in which faculty members work on industry-aided research partly bridge this gap between universities and industry.

Formal instruction is almost entirely by the lecture system without textbooks, problems, or homework. Laboratory equipment for instruction is mostly very old, though some laboratory programs appeared good. Graduates were criticized in general for being too exclusively theoretical, though we saw the beginnings of experimental ingenuity in some graduation thesis reseach. Very little graduate work as we know it is offered in Japan, the doctorate being essentially the certification of a thesis. Japanese universities, never affluent, are very poor financially today after a roughly 200 to 1 inflation since prewar. The effects are apparent. Professors spend 70 percent or more of their salaries for family food. Yet the spirit appears good. Private universities, some of which are important institutions, suffer more than the great tax-supported National (formerly Imperial) universities.

Since the early 1900's, European, and especially German, influence was dominant until the American occupation. Thus the pattern has been markedly different from that in the United States. Research rather than teaching-and-research is the commonly declared function of the university and its professors. A professorship is commonly regarded as a position of glorified authority which is relatively untempered by the qualities and ability of the incumbent professor.

While important work has come from such Japanese as Honda, Yagi, Okabe, Yukawa, and others, Japanese industry in general shows little influence of strong, original engineering. The ratio of engineers to total employees is a small fraction of the corresponding American figure. These facts and her efforts to industrialize rapidly make natural the close resemblance, and indeed often apparent identity between many Japanese products and western products.

In the universities, each "chair," consisting of a professor, two or more assistant professors, and a group of assistants, tends to be an independent and isolated unit of research and teaching, with little of the team spirit in any larger grouping that is so vital a part of our operations. Each institution tends to be highly self-sufficient. Intensive inbreeding of staff and students is regarded as a mark of quality. Apparently inter-institutional group discussions of engineering education occasioned by this Institute for Engineering Education were quite unprecedented as was the participation of industrial representatives.

Engineering libraries, woefully deficient in acquisitions since 1940, are much less used and useful than in the United States.

Dormitories and other student group living is virtually unknown in Japan, and the literal absence of any physical facilities for student study, at home or school, is a serious lack.

At the sub-professional level, the Semmon Gakko, equivalent of our post-high school technical institute, was abolished after the war in the attempt to provide more universities through upgrading of these Semmon Gakko to degree-granting institutions. This leaves a serious void in the technical education system.

Leading engineering educators in Japan, and these include men of real ability, are quite cognizant of many of these characteristics of Japanese engineering education. They apparently welcomed the Mission as an important means of presenting western methods and outlook to their many associates. That there was widespread and serious interest among them in engineering education problems and in our methods was clear from the many thoughtful and searching questions put to the Mission. While we covered our educational methods and philosophy thoroughly, we also stressed that they, the Japanese educators, should not copy, but must themselves think through their needs and aggressively develop methods answering these needs while making full use of all of the ideas available.

Although the Mission members went armed with detailed materials on American teaching methods in engineering, they quickly found that the Japanese were prepared to discuss matters of broad educational policy with insight and discernment. Several Japanese addresses at opening sessions pointed up pertinent problems. Discussions and questions prepared by the Japanese in advance of most sessions focussed subsequent discussion on issues important to them on which they desired the American point of view. Mission members were impressed with the basic similarity between many of the issues confronting engineering education in the two countries. On the other hand, the pattern of Japanese engineering education is essentially German and in many aspects is contrary to the spirit and methods in our country. Mission members used direct criticism sparingly. Rather they discussed the methods and point of view of our country with the reasons therefor, sometimes stating why under our conditions we should find a Japanese usage quite unsatisfactory. The accompanying "summary" from the Mission report presents the highlights of its conclusions.

One notable and not entirely expected characteristic of these discussions was the virtual unanimity of all Mission members, representing the greatest diversity among engineering schools over our country, on all important issues concerning engineering education. Methods of operation vary widely over our country, but statements of objectives, principles, policies, and even the spirit of these operations were surprisingly alike. No doubt the ASEE has been a powerful influence toward achieving this basic agreement as to what is important and good.

Topics of Discussion

The many sessions of the IFEE covered in some detail virtually the entire field of engineering education. Programs were evolved continuously as the sessions progressed by joint program committees. Specific topics at each session were introduced by the Japanese by well-thought-out and often searching presentations followed by definite questions. The over-all scope of program subject matter is suggested by the following partial list of subjects considered at the various sessions.

Undergraduate curriculum
- Time allocation to general education, science, common engineering, and major-field engineering.
- Technical level to be attained.

Teaching methods
- Lecture vs. discussion-recitation.
- Textbooks and homework.
- Co-operative courses.
- Laboratory methods.
- Importance of the library.

Students
- Selection and admission.
- Guidance.
- Academic standards and dismissals.
- Type of employment.
- Placement and salaries.
- Living arrangements.
- Costs.
- Student life.
- Extracurricular activities.

Graduate study and research
- Degrees and requirements for these degrees.
- Recognition by industry.
- Nature and level of work.
- Graduate researches.
- Fellowships, scholarships, and assistantships.
- Day and evening programs.

Faculty-student relations
- Attitudes.
- Spirit.
- Guidance.
- Counseling.

Faculty
- Selection.
- Basis for recognition and promotion.
- Tenure.
- Duties and responsibilities.
- Hierarchial relations or their absence.
- Responsibilities.
- Consulting privileges.
- Standard of living.
- Co-operation and team work.
- Place in the community.
- Place in their profession.

Organization and administration
- Institutional autonomy under the board of trustees.
- Career administrative officers.
- Faculty organization.
- Department unit.
- Sources of income.
- Junior college.

Industry-university relations
- Employment of graduates.
- Trustees from industry.
- Contract research.
- Patents and trade secrets.
- Co-operative courses.
- Grants and fellowships.
- Summer and sabbatical employment of faculty.
- Lecturers from industry.
- Visiting committees.
- Extension work.

ECPD and ASEE
- Relation to education and the profession.
- Functions.
- Accreditation.
- Procedures and methods of operation.

Problems peculiar to the educational reform in Japan under U. S. guidance.
- Lower terminal level for engineering students under the Japanese "New System."
- Loss of technical institute level of training.

Problems characteristic of individual branches of engineering
- Further discussions in group sessions by fields.

Among the team at least one and often many could speak to a subject from personal experience. Members rapidly became adept at organizing and giving terse verbal essays on very few minutes notice. Apparently our Japaneses associates were greatly impressed with the ability of Americans to do this and do it with assurance, poise, indeed finish, and in a voice that could be readily heard throughout a sizeable meeting hall. The obvious seriousness of interest of the Japanese in learning of our ways, evidenced by the quality and care with which they prepared for the meetings, their active discussions from the floor, and general attitude, made these sessions a challenge.

Report of the Mission

During the final week in Toyko a 100-page report with a 150-page appendix was prepared and officially submitted. It is essentially an essay on engineering education in the United States, which, being addressed in intent to Japanese engineering educators, reflects in its emphases the reactions of Mission members to the Japanese scene in education. This report, submitted to General Ridgway, was soon made available to the Japanese, who promptly began translating it into their language for wide distribution among those concerned with engineering education.

The summary appearing at the beginning of the report of the Mission is re-

produced verbatim as an accompanying paper.

In conclusion, a few impressions on the personal aspects of such a Mission are relevant. In auspices, as detailed in the appendix, this Mission was most fortunate. General Marquat gave it essentially *carte blanche* professionally. Travel and living arrangements (made by the Unitarian Service Committee under Army contract, and administered in Japan by Miss Dorothy E. Snavely of USC, Executive Officer of the Mission) were so well handled that they quickly became taken for granted. Thus the Mission worked under essentially ideal conditions—aside from heat somewhat worse than a Washington, D. C. summer, without air conditioning.

On the extracurricular side, regarded by SCAP as an important part of orientation to the Japanese environment, Mission members visited many places of cultural interest and natural beauty. They were honored guests at numerous teas and at official prefectural and city dinners. They had a notable visit with Mr. Kokichi Mikimoto, famous as originator of cultured pearls. Japan's fine hand industries such as cloisonne, demascene, lacquer, wood prints, and fine textiles were seen in detail. Several major Japanese street festivals were fortunately, if fortuitously, encountered. Other notable experiences of groups included white-water boating on mountain rivers, partaking of the famed public baths of Nabori Betsu, visiting the ancient Ainu tribe, sailing and boating on the scenic Matsushima Bay, visiting a number of Japan's fine shrines, and others. Small Japanese stores and shops, streets, and their people were perennially interesting. Even the transpacific flights, though involving three 10 to 13 hour hops, were not without interest.

The writer believes that he speaks for all of the Mission members in stating that as a professional experience the Mission proved stimulating and satisfying and that as a personal experience it was richly rewarding. The Mission believes that it may have contributed its bit to international understanding and good will.

Appendix

Organization of Engineering Education Mission to Japan

On October 13, 1950, Major General W. F. Marquat, Chief, Economic and Scientific Section (ESS), Supreme Commander Allied Powers (SCAP), wrote former ASEE President Thorndike Saville indicating support for an engineering education mission to Japan. He suggested that fifteen men, covering various engineering fields, spend eight weeks in Japan. President Dawson referred the letter to Dean W. R. Woolrich, as Chairman of the Committee on International Relations of the Engineering College Administrative Council of ASEE. Dean H. P. Hammond agreed to serve as chairman of the Mission, did much of the organization and recruitment of members, then had to withdraw because of unavoidable commitments that developed. The writer at this point accepted the chairmanship.

The Unitarian Service Committee, a nonsectarian, non-political, non-profit, humanitarian agency, accepted responsibility for administrative services under Department of the Army Contract No. DA–49–083–03A-256. Miss Dorothy E. Snavely, Assistant Director of Medical Projects of USC, accompanied the Mission as Executive Officer, caring for all living and traveling arrangements. Dr. B. C. Dees, Chief, Scientific and Technical Division, ESS, and Col. T. R. C. King, Personnel Branch, Office of Occupied Areas, Pentagon, were liaison officers in Tokyo and Washington respectively.

Members of the Mission served without compensation for services, but were paid a *per diem* allowance in lieu of living expenses. The USC-Army contract provided transportation within the United States. Outside the United States travel was under military orders. Food and housing were provided in military billets, actually in the first-class hotels in each area operated by the Army. VIP (Very Important Person) status was obtained for the Mission members, which provided facilities and freedom of action that greatly increased the Mission's effectiveness. Air Force transport within Japan saved several days of working time. Staff-car transport was available on call. Army backing and support was of high excellence throughout. The entire mission was without untoward incident.

Members of the Mission included:

BEESE, CHARLES W. Prof.—Director, Technical Extension Div., Purdue University, Lafayette, Indiana.

BRONWELL, ARTHUR B. Prof.—Dept. of Elec. Eng., Northwestern University, Evanston, Illinois.

CHEDSEY, WILLIAM R. Prof.—Dept. of Mining Eng., University of Illinois, Urbana, Illinois.

CHRISTIE, ALEXANDER G. Prof. Emeritus—Dept. of Mechanical Eng., The Johns Hopkins University, Baltimore, Maryland.

DIETZ, ALBERT G. H. Prof.—Dept. of Building Eng. and Construction, Mass. Inst. of Tech., Cambridge, Mass.

DODGE, BARNETT F. Prof.—Chairman, Dept. of Chemical Eng., Yale University, New Haven, Conn.

DODGE, HOMER L. Dr.—Director, Cabot Fund Program in Aviation, Norwich University, Burlington, Vermont.

FINCH, ROGERS B. Asst. Prof.—Textile Technology, Mass. Inst. of Tech., Cambridge, Mass.

HAZEN, HAROLD L. (Chairman of Mission), Prof. and Head—Dept. of Electrical Engineering, Mass. Inst. of Tech., Cambridge, Mass.

MILLER, ALFRED L. Prof.—Mechanics and Structures, University of Washington, Seattle, Washington.

SAUER, JOHN A. Prof.—Head, Dept. of Engineering Mechanics, Pennsylvania State College, State College, Pa.

STEEL, ERNEST W. Prof.—Dept. of Sanitary Engineering, University of Texas, Austin, Texas.

WALKER, HARRY B. Prof.—Engineering Experiment Station, University of California, Davis, California.

WILKINSON, FORD L. Dr.—President, Rose Polytechnic Institute, Terre Haute, Indiana.

WILLIAMS, ROBERT S. Prof. Emeritus—Dept. of Metallurgy, Mass. Inst. of Tech., Cambridge, Mass.

Summary of Report of the Engineering Education Mission to Japan

Explanatory note: This summary is taken *verbatim* from the report submitted to General Ridgway on 25 August 1951 by the Mission, which is described in the accompanying paper by the Mission Chairman, Dr. Harold L. Hazen. A limited number of copies of the complete mimeographed report (79 pp. + 130 pp. of appendices) are available at Unitarian Service Committee, 31 Union Square West, New York 3, New York.

The appendices include the names of the Japanese committeemen of the Institute for Engineering Education (the Japanese designation for the program of the Mission); the program of sessions of the Mission; list of talks by Mission members to professional societies; list of plant, public works, and university visits; and some of the prepared lectures given to and by the Mission as orientation and summary.

"In accord with its objectives the Engineering Education Mission to Japan has held many meetings in six regions of Japan for exchange of ideas with Japanese engineering educators. Available evidence indicates deep interest on the part of the Japanese and substantial success in achieving mutuality of understanding despite the language barrier.

"Believing that its value must lie in long-term influence, the Mission has phrased its report as well as conducted its sessions, in terms of suggestions based on American experience, rather than in terms of firm recommendations. The Mission believes that real advances must be made by the Japanese themselves in response to Japanese motivation and Japanese conditions.

"Specific suggestions of the Mission that are embodied in this report are the following:

"1. Each individual university should have a large measure of autonomy to develop educational policy and program in response to its special strengths, local conditions, and administrative leadership. The Mission believes that the administrative positions in universities down through department chairmen should be regarded as career opportunities with adequate incentives and responsibilities to assure strong positive educational policies and programs.

"The Mission advocates a large measure of professional freedom for individual staff members, including freedom to do consulting work with personal remuneration. Staff responsibilities should be broadly, not narrowly specified.

"The Mission also advocates a large measure of institutional freedom in fixing the terms and character of faculty appointments. The national public service type of appoint-

ment appears much too constraining to encourage the adequate development of high professional stature in an engineering professor.

"2. Flexibility within each university organization to permit its administration to respond positively and promptly to changing needs and environment is regarded as very important. Such flexibility should characterize the institutional policy for promotion and appointment of staff, for the use of funds within the total amount available to the university, and for all internal operations. The department is the smallest unit, in the Mission's judgment, that should be charged with broad responsibility, if the flexibility necessary to strength is to be achieved. The chair system appears unduly restraining.

"3. The Mission would emphasize closely interrelated teaching and research, rather than research alone as the major function of the university.

"4. Close and personal relations between faculty and students and between faculty members of all ranks are regarded as a very important element in engineering education.

"5. Much freer interchange of students and faculty among institutions and the minimization of 'inbreeding' in faculty are advocated.

"6. The sub-professional level of technical training represented by the former Semmon Gakko is vital to a balanced system of technical education and to a healthy growth of industry. A strongly vocational option in the new junior college is one possible way of providing such training. Another is the use of the former Semmon Gakko facilities to provide sub-professional, evening programs of a terminal character.

"7. Close relations between industry and engineering universities at all levels from student to board of trustees are very important elements of strength in American engineering education. Such close relations would greatly benefit Japanese engineering education.

"8. The Mission recognizes that Japan's engineering universities share the economic difficulties of the country. If Japan is to train the good engineers who will contribute greatly to economic health, she must recognize the inherent costliness of engineering education as compared to education where extensive laboratories are not required, and *find* the money.

"9. Japan's new four-year undergraduate engineering program will fall short a year or more of meeting the technical level of the old engineering degree. American experience indicates that a four-year engineering program is adequate for most engineering students. However, both day and evening graduate work should be provided for the minority of engineers needing more advanced technical preparation.

"10. The Mission strongly endorses the movement to establish an independent Japanese equivalent of the American Society for Engineering Education. Such an organization should greatly strengthen engineering education by bringing together regularly engineering educators and interested industrialists from all over Japan for mutual discussion of common problems.

"11. Japanese engineering libraries appear less widely useful and used than those in the United States where the library is as important an educational facility as the laboratory or classroom. Also, gaps in acquisitions during the past decade, a period of extremely rapid technological advance, are most serious. Freer circulation policies and methods, as well as the filling of serious gaps in holdings, are very important problems.

"12. The Mission believes that Japanese engineering education could benefit greatly by a more widspread use of textbooks and also by the use of the discussion-recitation technique with homework problem assignments. In the United States, hard individual study and work is regarded as the most important element in acquiring the rigorous analytical mental discipline which should be characteristic of engineers.

"13. National taxes imposed on gifts to public and private universities seriously discourage donations by philanthropists and companies. Removal of all taxes on gifts to universities would stimulate private philanthropy and would yield great returns in the further development of higher education in Japan.

"14. Because of the relative newness of many of the educational ideas now being explored and developed in Japanese engineering education, and the inevitable difficulties and discouragements that will occur in such a rapid change, it is suggested that a follow-up, perhaps a smaller mission, might be useful one, two, or three years hence. Such a mission should include some of the present mission personnel plus some new members."

The Engineer—A Parable

By D. B. STEINMAN

Consulting Engineer, New York City

One day three men—a Lawyer, a Doctor, and an Engineer—appeared before St. Peter as he stood guarding the Pearly Gates.

The Lawyer stepped forward first. With confidence and assurance, he delivered a glib and eloquent address which left the Saint dazed and bewildered. Before Peter could recover, the Lawyer slipped him a writ of mandamus, pushed him aside, and strode through the portals.

Next came the Doctor. With impressive bearing, he introduced himself: "I am Dr. Brown," he announced. St. Peter received him cordially. "I feel I know you, Dr. Brown. Many who preceded you said you sent them here. Welcome to our City!"

The Engineer, shy and retiring, had been standing in the background. He now stepped forward modestly. "I am looking for a job," he said. St. Peter wearily shook his head. "I am sorry," he replied; "we have no work here for you. If you want a job, you can try the other place."

This response sounded familiar to the Engineer, and made him feel more at home. "Very well," he said, "I have had Hell all my life and I guess I can stand it better than the others."

Peter was puzzled. "Look here, young man, what are you?" "I am an Engineer," was the reply. "Oh yes," said the Saint, "a member, no doubt, of the Locomotive Brotherhood?"

"No, I am sorry," the Engineer responded apologetically, "I am a different kind of Engineer."

"I do not understand," said St. Peter. "What on Earth do you do?"

The Engineer recalled a definition and calmly replied: "I apply mathematical principles to the control of natural forces."

This sounded meaningless to St. Peter, whose temper was always a bit uncertain. "Young man," he said; "you can go to Hell with your mathematical principles and try your hand on some of the natural forces there!"

"That suits me," responded the Engineer. "I am always glad to go where there is a tough job to tackle." Whereupon he departed for the Nether Regions.

Soon thereafter strange reports began to reach St. Peter. The Celestial denizens, who had amused themselves in the past by looking down upon the less fortunate creatures in the Inferno, commenced asking for transfers to that other domain. The sounds of agony and suffering were stilled. Many new arrivals, after inspecting both places, selected the Nether Regions for their permanent abode. Puzzled, St. Peter sent messengers to visit the place below and to report back to him. They returned, their wings aflutter with excitement.

"That Engineer you sent down there," reported the messengers, "has completely transformed the place so that you would not know it now. He has harnessed the Fiery Furnaces for light and power. He has cooled the entire place with artificial refrigeration. He has drained the Lakes of Brimstone and has filled the air with cool, perfumed breezes. He has bored tunnels through the Obsidian Cliffs and he has flung bridges across the Bottomless Abyss. He has created paved streets, gardens, parks and playgrounds, lakes, rivers, and beautiful waterfalls. That Engineer has gone through Hell and has made of it a realm of industry, peace, and happiness."

A "Year-in Industry" for Educators

By DAVID L. ARM

Dean, School of Engineering, University of Delaware

"Industry has a profound interest in, and responsibility for, contributing to engineering education. The key to quality leadership for our nation and its industries is in the hands of our colleges. To use this key successfully, our colleges must clearly understand their problem, not as it used to be, but as it is today, and as it will be tomorrow."

This statement by Dr. Granville M. Read, Chief Engineer of E. I. du Pont de Nemours & Company, on January 20, 1951, inaugurated a unique program of cooperation between a large and diversified engineering department and engineering education. The occasion was the Second Annual Industry-College Conference sponsored by the American Society for Engineering Education which was held on the campus of the Case Institute of Technology in Cleveland.

Specifically, Dr. Read offered to invite several engineering educators into Du Pont's Engineering Department each year on leave of absence from their regular college duties. He proposed that these educators spend 12 months, not on direct job assignments, but on a schedule taking them through the entire engineering organization. The purpose of the program is to give each participant an opportunity to study, from a top management viewpoint, the organization and operation of a large and complex engineering department.

In order to insure the most effective utilization of the program's benefits, it was decided that invitations would be extended to engineering educators who had wide influence in their respective colleges and who were responsible for the determination of educational policy. Accordingly, those holding positions of Dean, Assistant Dean or Department Chairman in accredited engineering colleges and who take active parts in the activities of professional and technical societies were to be invited to participate.

The program actually began on April 1, 1951, when the writer, who was honored by being selected as the first engineering college administrative officer to be invited to participate, reported at the Du Pont offices in Wilmington, Delaware, to begin his "Year-in-Industry." John W. Whittemore, Associate Dean of Engineering at the Virginia Polytechnic Institute joined the program in July, and Virgil M. Faires, Professor of Mechanical Engineering and Head of Post-Graduation Studies at the Texas A. & M. College, began his participation in August. Since the writer is now completing his year's participation, he believes that it would be timely for an evaluation of the benefits accruing to both engineering education and industry. A number of our leading industrial companies have recognized their obligation to assist engineering education and have sponsored seminars and conferences in which many representatives of engineering faculties have participated. As those who have attended these programs are well aware, the pattern of these efforts varies widely and the time devoted to them ranges from several days to as much as several months. A few industrial concerns hire younger faculty members of engineering colleges for direct job assignments in their engineering organizations for periods ranging from the summer vacation to employment for a full year. So far as can be deter-

mined, however, the Du Pont "Year-in-Industry" is the only program of such comprehensive scope and with as much continuing effort by the sponsoring organization.

Objectives

All programs of the types mentioned have the following common objectives:

1. To acquaint faculty representatives with the sponsoring organization by giving them a broad view of its organizational structure, its activities and its operating problems.
2. To acquaint the participants with the company's philosophies and practices with respect to customers, stockholders, employees and to the community.
3. To make available information about the American business system and how it operates.
4. To make known the educational requirements of the company for potential employees.
5. To give participants an opportunity to learn about careers for graduates with the company or with the particular industry represented by the company.
6. Through discussions, to enable the company to benefit from ideas and observations of the educators.

Activities

During the past year, the writer has had the opportunity of observing the organization and operation of a department whose activities are perhaps more diversified than those of any other engineering organization. These activities range from fundamental research, through the development of special instruments and machines, the complete design and construction of new industrial plants and installation of the equipment, to the rendering of engineering services to plants in full production. In addition, the department conducts its own personnel, training, accounting, and cost estimating functions. It has approximately 3000 people on its salary roll and an additional 35,000 in its construction force which presently is constructing new plants or enlarging existing Du Pont plants at 23 locations from New York to Texas. It has just completed the design, construction and placing in operation of a new cellophane plant for one company and is designing and constructing a complete new plant for the production of nylon for another, both becoming competitors of Du Pont. Also, it is engaged in the design and construction of huge new facilities which will be operated by Du Pont for the Atomic Energy Commission.

Every effort has been made by Du Pont to insure success for the "Year-in-Industry" program. With the exception of classified work being done for the Atomic Energy Commission, no policies, costs or procedures have been withheld from the participants. We have had the opportunity of observing and discussing all phases of the work of the department. We have discussed organizational and operational problems with representative people from the craftsmen in the field and engineers in the offices and the plants to managers of the several divisions of the department. We have spent a considerable amount of time with the construction forces on several different projects. We have been privileged to visit many of the research laboratories and plants and have been invited to attend meetings whose subjects covered the entire range of engineering. We have observed the various specialized training programs and have taken an active part in some. No individual has been told what he may or may not discuss with us, describe to us, or show us. In fact, it seems to us that everything that could have been done to make our "Year-in-Industry" more pleasant and profitable has been done. We have had the wholehearted cooperation, not only of management, but of countless individual workers.

In the 22 years that have elapsed since the writer left industrial employment to enter the engineering teaching profession, many significant changes have, of course, occurred. Not only have products and manufacturing processes changed con-

siderably, but manufacturing tools and facilities have been greatly improved. However, the greatest change for the better, it seems to us, has been in the field of human relations.

Improved Human Relations

All jobs have been made more pleasant, safer, and easier to accomplish with a minimum expenditure of physical effort and with a consequent decrease in fatigue. The worker is well protected against financial crises from accidents and illness and every effort is made to insure his financial independence after retirement. In the event of his death, his family is protected by liberal group plan life insurance. He has the highest standard of living in history with the shortest working hours and unequalled recreational facilities. All these things we have found to be true in Du Pont and we believe that this company is representative of modern industry. As for young engineers, we see unlimited opportunities to travel far along the route of professional advancement and satisfaction.

Benefits

It seems to us that the type of program in which we have been engaged yields the following benefits:

1. Through an interchange of information, both industry and engineering colleges better understand each other's problems.
2. It should make for educational programs better suited to the needs of industry.
3. It should result in better counseling of students.
4. It enables the individual who participates to observe at first hand engineering in action.
5. It creates good public relations both for industry and for engineering education.

The greatest benefits are long-range and perhaps can never be subject to complete evaluation. It seems logical to assume, however, that as more engineering college administrative officers take advantage of such opportunities the benefits to engineering education will increase accordingly. All industry will then be supplied with better trained graduate engineers because of better policies, methods, and philosophies adopted by the engineering colleges. Because we are thoroughly convinced of the value of this type of program in promoting better understanding between industry and engineering colleges, we should like to see more companies follow the lead of Du Pont. The very nature of the program which we have just completed involves a tremendous expenditure of time and effort by the sponsoring organization so that not more than five participants per year could be accommodated by any one company. This leaves much ground to be covered if all accredited engineering colleges are to be given the opportunity of participating in programs of this sort. Since the benefits accrue to all industrial companies, other progressive organizations might well consider similar plans. Since the salaries of the participants, plus reasonable expenses, are paid by Du Pont, the direct financial expenditure is sizable. We have been assured, however, that Du Pont believes that the cost in time, money and effort is well worth while. Certainly, we who are participating are sure that the investment of our time and effort has been well repaid and will reap future dividends.

An Adventure in Engineering Education

By J. TRUEMAN THOMPSON

Professor of Civil Engineering, The Johns Hopkins University

and

W. WORTHINGTON EWELL

Assistant Professor of Civil Engineering, The Johns Hopkins University

This is the story of an experiment which has resulted in a course known as "Library Projects" now included in the Civil Engineering program at Johns Hopkins. The experiment arose from our observation that engineering students cannot write as well as they should, and that the scope of their interests is too limited. Of course no one is to blame for this but their mentors, who, blinded by the importance of their own specialties, have insisted on technically burdened curricula and overcrowded programs.

We had also observed that although the combined libraries of The Johns Hopkins University contain some 800,000 books, and that nearly five hundred engineering undergraduates each day wander contagiously close to these establishments, only an ambitious few are tempted into doing business. Nor is this phenomenon peculiar to the Hopkins campus; it is safe to guess that there are other universities with library stacks left undusted by their engineers.

And even when the typical engineering student does enter a library, he usually does so in order to fulfill a certain need. Unfortunately, self-motivation seldom prompts either his entrance or his need. Almost invariably he is out to gather some facts for use in connection with some technical report or problem, at the insistence of some professor who probably has made the procedure as painless as possible by arranging for the presence of the needed material on the reserve shelf.

And when he has the facts, all too often he presents them in a document that is a far cry from his more carefully written productions of Freshman English. There at least the quality of his writing was criticized—here it is ignored—attention is focused solely on technical accuracy. The plain facts are that very few teachers of engineering care a hoot about the literary value of a report, and not more than a trace of such student papers offer any real opportunity for a display of writing skill.

Evolution of the Course

It took several years of experimentation to evolve the course which is proving so useful and enjoyable to both faculty and students. In its evolution we kept three objectives constantly in mind. First, we felt it was important that our students learn how to use libraries intelligently and efficiently. Next, we believed that nothing we could do for them was of more consequence than to convince them of the importance of being able to write well and to help them to improve their skill. And finally we were sure that as a collateral we would earn their everlasting thanks for the vistas opened to distant horizons by the inculcation of the "library habit."

Lest we be judged presumptuous by our colleagues in our Department of Writing, Speech, and Drama, our library staff, and our readers, let us hasten to say that from the inception of the thought, through its

experimental development and on into its mature application, we have had the advice and cooperation of our friends normally responsible for instruction in writing and in the use and operation of the libraries. One is justified in asking why we did not turn the job over to these professionals, who are admittedly more competent in the field than a staff of engineers. There are two reasons. One had to do with convenience. The complete informality which we held so important to the undertaking demanded that each participant be a member of a small group, say not more than a half dozen, under the tutorial guidance of a faculty member especially chosen for his ability and above all for his interest in the adventure. There are no fixed schedules. The whole class meets not more than a half-dozen times during the year and then only when, at the beginning, plans and intial instructions are being discussed, and at other times when important corners are being turned in the course.

The other reason was based on the belief that it would appear novel to our students to discover that older, more experienced and respected engineers consider the subject of great importance. By contrast, our colleagues in English would naturally be interested in writing and in library research. Faith in this psychology has been amply justified.

As has been stated, one of the objectives of the course is to stimulate an interest in the library through a more intelligent use of its services. How is this accomplished? Since the key to the effective use of any library is found in its reference books, card files, indexes, and bibliographies, the first hours of the course are spent introducing these tools. Thereafter each student spends an hour or more of each week personally ferreting out of the libraries miscellanea of every conceivable sort.

Assignments Varied in Nature

Why should the assignments be so varied in nature? After saturating the undergraduate with a four-year flood of technical subjects, why should the assignments be anything else? Our students know of Castigliano and of his contributions to structural analysis, so they are asked to learn something of Castiglione and his contributions to Italian literature and diplomacy. On the other hand, they may be on intimate terms with Sir Walter Raleigh, while Lord Rayleigh waits to be introduced. But personalities are not the students' concern for long—encyclopedias and biographies yield their information too easily. For the next few hours, they scan the Engineering Index for all of the important articles on Space Frames, or they leaf through the Reader's Guide to Periodic Literature in search of a magazine article entitled "South of Khyber Pass." Rapidly, the assignments become more detailed in nature and the seeker finds himself involved in a multi-phased search. A progressive passage through the World Almanac, The Who's Who for 1900, and the Congressional Record might be necessary to answer the question, "Who was the elder senator from North Carolina in 1900, and what was his most important contribution on the Senate floor during that year?" In all of these initial ventures, the students have only to furnish an answer and to state the source of their information.

As the course progresses, the assignments become more subjective, with the intention of arousing interest in the answer as well as in the search. Delighted with the nonsense answer of the "Holy Bottle," one student read more of the adventures of Rabelais' "Pantagruel." Another student, investigating the subject of "post-inpressionism," was moved to visit the Matisse collection at the Baltimore Museum of Art. And a third, intrigued by his newly acquired knowledge of "The Forms of Music," visited the Music Room of the Enoch Pratt Library in Baltimore, where he listened critically to several recordings to see if he could recognize the difference between the concerto and the symphony and detect the appearance of the cadenza in the former. During this phase of the course, we re-

quire that short essays on the subjects be submitted for criticism.

Ultimately, the real project phase of the course is begun. Calculated to test the students' newly acquired abilities, subjects such as "The Colonization of Africa" and "Bird Life Along the Gulf Coast" are suggested. The freest selection of topic is encouraged, provided that the subject is sufficiently broad in its scope. Written reports on such library projects are rarely successful when they fail to draw from all available library facilities.

Preliminary excursions through the libraries acquaint the student with his selected theme and enable him to make tentative restrictions on the broad topic. Out of the welter of information concerning African Colonization may come a decision to report on "The Transvaal, Former British Colony." Eventually, a preliminary outline on this necessarily restricted phase of the general project is submitted.

Research

After gaining approval on his particular interest, the student is free to proceed with the serious business of research. This follows a series of well-ordered rules. The preliminary brief is developed into an organized outline of the subject and as these ideas coalesce, a working bibliography is gathered together. Next, notes are taken on small cards which permit the expression of only a few ideas directly pertinent to one small portion of the outline. Eventually the student has before him a series of card notes amplifying every item in his outline and a completed bibliography from which he can draw additional information. By this process, he has gained a familiarity with the subject that permits him to write a short but nevertheless bona fide research paper.

The mechanics of the course are simple, allowing a great amount of flexibility. As noted above, the class is divided into groups of not more than a half dozen, and each division is placed under the guidance of a different instructor. Both students and staff members are forced to accept new techniques and view points several times a year under a simple rotational system. In order to supplement instruction by the staff, the text book "The Research Paper," by Hook and Gaver, is used by all class members.

What is Accomplished?

What does this new course accomplish? We believe that it does three things. Of primary importance is the knowledge gained of library facilities and techniques. For those who continue their education in the Hopkins graduate schools, the ability to conduct an intelligent library research is of indisputable value. For those who enter industry, many questions inevitably arise whose answers can easily be found only on library shelves.

Too many engineering students have a disdain of anything that cannot be formularized or converted into practical value. The Library Projects course offers them one last chance to throw off this pall of indifference in which they have been shrouded. In this respect the instruction has been singularly successful. Out of their weekly visits to the library, there comes to most students an awakened interest in things non-technical. Probably because they suffer so badly from an obvious dietary deficiency, engineering students grasp more hungrily than most at fare grown in the garden of words and ideas.

The experience gained in writing the short essays and the final research paper cannot be minimized. There are some who will decry the value of these efforts by claiming that written technical reports produce the same effect. Actually, the effects are not the same, for the efforts that produce them are far from alike. To prove this, one has only to contrast the uninspired efforts put forth on the average technical report with the enthusiastic applications shown in a subject that arouses personal interests. One always writes best and with the greatest ease and enjoyment on a subject of one's own choosing. The

Library Projects course adheres strictly to the principle of free selection of subject matter and in doing so fosters the student's best efforts. The quality of the short essays and the research papers attests to this.

This complex and ever-changing world demands an appreciation of it which is often lacked by members of the applied and exact sciences. And many engineers and scientists will live and die in their own tightly circumscribed little worlds, completely unaware of their lack. Courses like "Library Projects" may help some of them add a little color to the drab fabric of their everyday existence.

Sections and Branches

The 18th annual meeting of the **Southeastern Section** of the ASEE was held at Clemson, S. C. with Clemson College as host on April 10, 11, and 12th.

On Friday morning the meeting was called to order with R. L. Sumwalt presiding. The Chairman introduced M. I. Mantell who presented a paper on "Admission Requirements for Engineering Schools." C. H. Brown followed with a talk entitled "A Program for the Engineering Profession." The third speaker was C. F. Hudgins with a paper on "High School Counseling."

S. C. Hollister, President of the ASEE, discussed "The Critical Shortage of Engineers." Dean Hollister told of the work of the Engineering Manpower Commission and showed how the estimated 20,000 graduates a year were obtained from a total of 800,000 18-year-olds. Dr. Hollister cited the increase in the percentage of engineers to the total labor force and made the observation that the profession has become of age. He cautioned against over-expansion, and stated the need is for more engineers with better training, and not just graduates.

The Chairman next introduced O. Meier who outlined "A High School Guidance Program for Prospective Engineering Students." J. D. Lane spoke on "Science in Our Times."

The following names for officers of the Southeastern Section for next year were presented: Chairman, T. V. Terrell; Vice-Chairman, J. R. Cudworth; Secretary-Treasurer, B. M. Bayer; Representative on the General Council, F. H. Pumphrey (elected in 1951 for two years). A motion was made that the nominations be closed and that the names presented be elected by acclamation. The motion was seconded and passed.

The annual meeting of the **Rocky Mountain Section** of the ASEE was called to order by Section Chairman E. J. Lindahl at the University of Wyoming on April 19, 1952.

H. T. Person introduced the first speaker, W. C. van Dyck, who presented a paper on "Some Present and Long Range Trends in Industrial Recruiting and Training." T. H. Evans gave a talk on "The Moves for Unity in Engineering."

The following slate of officers was nominated and unanimously elected for 1952-53: Chairman, C. A. Hutchinson; Vice-Chairman, A. Diefendorf; Secretary, K. H. Stahl.

The 17th annual meeting of the **Allegheny Section** of the ASEE was held on April 18, 1952 at the Pennsylvania State College. M. M. Boring, Vice-President of the ASEE, was introduced and the other National Officers who could not be present sent their regrets. The following papers were presented: "Improvement of Engineering Teaching," by B. V. Moore; "The Opportunities for Young Engineering Teachers in ASEE Activities," by M. M. Boring; "Pitching and Catching," by J. O. Perrine. The following names for officers were presented: Chairman, C. H. Cather; Vice-Chairman, I. W. Short; Secretary, A. L. Reed. It was moved and seconded that nominations be closed. Motion was carried.

Tests for Engineering College Applicants and Enrollees

By A. PEMBERTON JOHNSON

Project Director, Educational Testing Service

The Pre-Engineering Ability Test, an 80-minute combined half-length version of the two parts of the Pre-Engineering Inventory which are most predictive of 1st term engineering grades, is replacing the *Pre-Engineering Inventory* in a number of engineering colleges. Although the 4-hour Short form and the 6-hour Long form of the Inventory are continuing to be used at certain engineering colleges, the demand for these longer forms appears not to justify their sale after June 30, 1952. Accordingly the general sale of Pre-Engineering Inventory test books will be discontinued after June 30, 1952, although present users who need books can be accommodated. *Answer sheets will continue to be available.*

In the same way that the Pre-Engineering Ability Test has replaced the Pre-Engineering Inventory for local use of engineering colleges, the *College Entrance Examination Board tests,* particularly the Scholastic Aptitude Test, has replaced the former National Testing Program of the Pre-Engineering Inventory. The College Board tests, being available at up to 500 centers in the United States and in 20 foreign countries five times a year, are especially useful in evaluating applicants who cannot conveniently travel to the college (s) to which they are applying.

The *College Transfer Test* available at the same times and places as the College Board tests is coming into wider use as a means of evaluating the general ability level of transfer applicants. Use of the Sophomore Engineering Achievement Tests for this purpose and for end of Sophomore year evaluation has declined to the point that sale of test books for these tests is being discontinued June 30, 1952. Sophomore Achievement Test answer sheets will continue to be available.

A new 3-hour Advanced Test in Engineering of the Graduate Record Examinations became available in the fall of 1951 for evaluating a college senior's or graduate school applicant's ability to apply his engineering background to appropriate problems in basic engineering science and in one of four major fields: Chemical, Civil, Electrical or Mechanical Engineering. This test may be taken by individual students or entire senior classes.

Additional information regarding any of these tests may be obtained from Dr. A. Pemberton Johnson of Educational Testing Service, Princeton, New Jersey.

"Winning Teams"*

By ERHARDT C. KOERPER

In Charge of Special Projects Engineering, A. O. Smith Corporation, Milwaukee, Wisconsin

This subject was chosen with emphasis on the "team," rather than on the "winning" because when a good team is intelligently directed there is little question about its probable success. The primary consideration is the team and its membership.

A team can be defined as a group of individuals, each with his specialty complementing the other's toward the accomplishment of common objectives. For the moment, let us give particular attention to the "engineer-technician" teams now working in industry, commerce and science.

Team Characteristics

An effective winning team must first have a worthwhile objective, then inspired leadership with able working members and finally, a persistence born of inspiration. A certain spiritual quality must be present for success, and, if present, will be a guiding light toward worthy and lasting objectives.

Leadership depends primarily on the ideas and ideals of one individual or a very small group of individuals. These personal spark plugs establish the potentialities of the objectives. However, the spark must be transmitted to the working members of the team before leadership is effective.

In every organization there are certain optimum relationships between the specialization of its members. In earlier years, the ideas of an alchemist or inventor were generally embodied by his own hands and he was limited to that extent. At that time our standard of living had not risen to take advantage of many new ideas. Neither was an extra 10 years considered critical in getting a new mousetrap into the hands of the public. That tempo has little place in our life today.

As education became more available to the masses, technical leadership forged ahead. However, with technical specialization there developed a gap between the idea and its embodiment. As this economic waste became more apparent the logical step to overcome it was the training of specialized members who could be effective associates in a "winning team."

Team Work

The teams in industry are not as clear-cut in their organization as are the athletic teams. Neither can the result be so closely associated with any single team.

Our modern, technical teams are made up of engineers, technicians, scientists, and skilled artisans all working together. These are the combat teams of industry, whose integrated knowledge, ingenuity and esprit de corps make possible our technical advancement.

The good things we have of life today come out of thousands of such teams. The steam engine, the automobile, the airplane, television and radar; our power generating plants; the clothes we wear; the gadgets we buy—all these are possible because a large number of specialists have cooperated in focusing their respective abilities toward products for markets.

* Condensed from the annual address at the James H. McGraw Award to Robert Hoover Spahr on June 26, 1951 through the Technical Institute Division of the American Society for Engineering Education at East Lansing, Michigan.

The addition of more adequate training and a better integration of these team members helps go for the greatest possible progress.

Results of Teams

For example, take a pocket watch, originally known as the "dollar" watch. Not for technical reasons it has inflated to $4.25. Without the results of team work we wouldn't even have a vise to hold the watch. The best tool available would be a stone chisel—and of course we would have no steel.

Look at only a fine screw in this watch. It alone required many crews of correlated workers to design the equipment and instrumentation needed for its manufacture.

Thus, steel selling for about 25¢ a pound was transformed into these little screws, selling for at least $500 per pound. This added value was designed into these minute screws and yet the watch weighing about 3 ounces sells for $4.25, or for less than 3 hours wages of the average American worker's time.

Then came the teams that developed, built and maintained the equipment for making it and putting the rest to the watch together, and testing it. In addition there are the modern pioneers who are constanly extending our economic horizons by research for a still better watch at a still lower price.

Fifty years ago a watch of similar accuracy, if then available, would have required 1 to 3 months of the same worker's salary. This value, multiplied no less than 1000 times, is indeed a great tribute to the effectiveness of technical teams.

On the other extreme in weight, we currently mass-produce automobiles which sell in the range of fifty cents to a dollar per pound. This highly complex vehicle is cheaper than beef steak; at present prices even cheaper than hamburger.

Slaves of Society

Early in civilization wealth was often measured by the number of slaves owned. Such slaves working most energetically could only produce at an average rate of less than 1/15 horsepower. The ownership of only a single human slave was the sign of a plutocrat. Where do we stand today on the matter of slave labor?

Now, in comparison, each of us is a millionaire. National averages give each of us about 6 kilowatts of electrical power, or the equivalent of about 100 man power. These electrical slaves are alert, efficient, ever ready to serve our bidding at any time of the day or night, in winter or summer.

Let us pay each of these slaves his current competitive rate. On this basis we would receive the fantastically low rate of 1/10 of a cent per hour. Though difficult to realize, this means that every man, woman and child in our United States has an average of 100 efficient slaves available at a total cost of only 10 cents per hour. Is there any question how we can produce at high rates and maintain high standards of living? Are there any limits to the good we can do?

The significant fact is that all these accomplishments have been made possible through the constant striving of hundreds of effective technical teams working in a favorable economic climate.

International Technical Leadership

Scientific and technical leadership is in international transition. Certain phases of it are moving from Europe to the United States.

For many years the European schools and industries have sent us a rich supply of scientists, engineers, and technicians. This supply of good men, especially of high-grade technicians, has been shut off. Now, lacking that vitalizing source, we must assume the responsibility of adequately training our own team members for technical survival and growth.

In Russia the technical team is recognized as a very effective means for becoming more competitive. Their literature is showing rapid progress in many fields with such teams. We hear that there are between 100 and 300 technical in-

stitutes behind the Iron Curtain. For comparison we have perhaps 50, of which only about half are accredited. As for size, the overwhelming chances are that the Russian counterparts are considerably larger than ours.

Economic Climate

Even though we need many more technical teams, those we have tend to be more effective than those of our totalitarian competitors because of four very important and basic factors which help define our economic climate.

We should know more about these factors, not only to take fuller advantage of them, but also to preserve their inherent virtues for the individual against the inroads of indifference and false security. These factors, are our:

1. Competitive system of free enterprise which rewards the individual on a basis of his productivity.
2. Personal productivity is multiplied through the intergration of specialized personal abilities.
3. Mass demand for products is maintained by high take-home pay for individual productivity.
4. Patent system encourages equitable reward and keeps invention competitive for the good of the public.

Ratios of Team Members

The winning team in industry, has changed its shape and activity over a period of time. It continues to change.

The pioneering Spahr-Wickenden report of 1929 showed that such teams were made up of about three technicians for each professional member. About 14 years later another basic report, in which Mr. Spahr was again a major contributor, showed an average of about five technicians for each professional member.

The difference between these two figures was caused in part by the addition of the distributive industries in the latter report, and in part to the increasing use of technicians since the first-mentioned report. In some industries where servicing and installation is high, the ratio now goes up to 11 technicians for each professional member.

Currently, the number of qualified technicians graduating as compared with the engineers graduating is in the ratio of approximately one to one. If the spade work is to be done in ratios ranging between 5 to 11, to each professional member we must ask the question, "Are we keeping technically abreast of competition?"

Technical Institute Progress

This Division is progressing soundly on the basis of established fact and analysis. These have included: 1) analysis of Technical Institute type of curricula, 2) a study of the jobs of Technical Institute graduates expressed in the same basic terms used to describe individuals, and 3) constant upgrading of academic quality through curricula accrediting by ECPD and course approval by NCTS.

Objectives

The following major objectives will help in building and utilizing winning technical teams:

1. Establish a clearer understanding of the nature and function of the technician. Until this is undertood their utilization will only be a small fraction of what it should be.
2. Dignify the term "technician" or its substitute. Both the technician and the engineer, as well as management need to recognize their mutual interdependency.
3. Develop closer contacts with industry in order to better train technicians as well as to encourage their broader utilization. The technicians' education is unique and should not be deviated by either trade school or college educational objectives.
4. Give students better counseling which is based on facts about jobs as well as individuals.

In Appreciation

Those in industry who see the serious problem of developing winning technical teams appreciate and hold in high regard the efforts of the Technical Institute Division of the American Society for Engineering Education and are anxious to work with you. Already you have made great strides of progress. You still have broad, fertile fields to clear and to cultivate. I know that you will continue to be increasingly successful.

College Notes

Plans for dedication of the new Metals Processing Laboratory at the **Massachusetts Institute of Technology** on Tuesday, June 3, have been announced by Dr. Thomas K. Sherwood, Dean of Engineering at the Institute. The dedication program will be followed on June 4 and 5 by a two-day technical conference on metal cutting which will feature speakers of national reputation in the metal cutting field.

Dedication exercises for the new building, made possible by a gift of $1,000,000 from Alfred P. Sloan, Jr., Chairman of the Board of General Motors Corporation, will include a presentation address by Mr. Sloan and an address of acceptance by M. I. T. President, Dr. James R. Killian, Jr.

Recent developments in Aeroelasticity will be reviewed in a special course to be given from July 14 to July 22 during the 1952 Summer Session at the **Massachusetts Institute of Technology.**

The program has been designed for both the practicing aeroelastician and the engineer in related fields. General topics will include Introduction to Aeroelasticity, Aerodynamic Tools of the Aeroelastician, Theoretical Solution of Practical Aeroelastic Problems, and Dynamic Models and Wind-Tunnel Testing.

The appointment of John E. Dean to be professor of electrical engineering and head of the electrical engineering department at **Colorado A & M College** is to be effective August 1, 1952.

Admiral Edward L. Cochrane, head of the Department of Naval Architecture and Marine Engineering at the **Massachusetts Institute of Technology** since 1947, has been appointed Dean of the School of Engineering.

Admiral Cochrane succeeds Dr. Thomas K. Sherwood, Dean of Engineering since 1946, who has asked to be relieved of the administrative duties of the dean's office to devote full time to teaching and research in chemical engineering, in which he has been a member of the faculty since 1930.

How Can Industrial Training Aids be Adapted for Classroom Use?

By JOHN GAMMELL

Supervisor of Sales Training, Allis-Chalmers Mfg. Co., West Allis, Wisconsin

The education and training that engineers receive in college is continued by industrial companies that employ them. Unlike colleges, employing companies can use an economic yardstick in measuring the usefulness and effectiveness of education and training. It is largely for that reason that industry has turned to training aids as a means of speeding up, and in some cases, improving the learning processes. Training aids make it possible for industry to train more men quickly and to conserve the time of skilled instructors as well as the time of the trainees.

It is felt that some industrial training aids may be used in modified form by colleges and universities as teaching aids. The author would like to discuss some of the visual training aids used by the Allis-Chalmers Manufacturing Company which are considered typical of industry.

Industrial training aids, generally, fall into two categories: job training and sales training. Sales training also includes those materials which are actually used as sales tools by field salesmen. Job training aids are of little value to colleges since they are usually of limited scope, treat specific instances rather than principles, are built around the rules and practices of a specific company and are planned for a relatively untrained mind. Sales training aids and sales tools, on the other hand, may often have a high value to the engineering school.

Industrial Films Available

There is one other instrument of learning which does not properly come under either of the above headings, but which may be available to colleges. Occasionally scientific investigations conducted by industrial companies are done in such a way that the experiment is, in a sense, reproduceable in the classroom. Most companies are happy to supply prints of films (for example, where the work is not a government or commercial secret) at cost or less.

The form in which these materials are available varies depending on the purpose for which they were prepared. One of the most common materials, of course, is motion picture film. Almost every company of any size has one or more motion pictures of their products which may have some interest and value for the engineering student. Many companies also have slidefilms, both silent and with sound, which are particularly valuable as teaching aids because of their adaptability. Some companies supply their salesmen with various types of scale models or schematic devices to illustrate the principles of the machine or product which the company manufactures. Most companies would probably be glad to order extra units and sell them to colleges at cost or less.

It is recognized that most of these materials are not designed in such a way that they can be used in classrooms without some modification. Many of them are

pitched at too low an audience intelligence. Many of them go into commercial details which are not of importance to the college student or for which he does not have time. However, adaptations can be made. These aids can be edited at the colleges with little student assistance. Others can be edited at the source.

For example, if a college instructor saw some individual frames in an Allis-Chalmers color slidefilm on centrifugal pumps that he was able to use in his own work, the Company can furnish that material in many forms. It can furnish the complete film with record. It can furnish a print of the film only, which can be cut and spliced in any way desired. Commentary can be added by either speaking directly or using a tape recorder. Editing sound motion pictures is a little more difficult since the sound track is not on the same section of film as the picture which accompanies it.

Large print in color or black and white of any single frame or frames from the film can be furnished. These can be used for lectures or for bulletin board material. Photographic prints up to 16×20, and on occasion larger, of any photographs in the company's sales literature or files can be supplied. If, in a design class, an instructor wants to discuss a pump design as it actually is done by one commercial firm, a large copy of a cutaway drawing may prove helpful.

It seems that many of the commercial angles involved in manufacturers' training aids should not be objectionable from the academic point of view. The students will go out to live in a commercial world. Where commercial practice can be combined with the theoretical material, the result is not detrimental, but actually beneficial.

In the News

The National Science Foundation has announced approval of 41 research grants, totaling $406,660, in the biological and physical sciences. This is the second group of research awards to be announced this year under the Foundation's program for the support of basic research, bringing the total number of announced Foundation research grants to 69. Additional proposals are being evaluated by the staff of the Foundation with the help of advisory panels of outstanding American scientists. Grants in this group were made to institutions in California, Connecticut, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New Jersey, New York, Oklahoma, Oregon, Pennsylvania, Rhode Island, Tennessee, Texas, Utah, Vermont, Wisconsin, and Hawaii. The research fields included are biochemistry, biophysics, chemistry, comparative physiology, developmental biology, endocrinology, engineering, enzyme chemistry, experimental plant biology, genetics, microbiology, oceanography, physics, pharmacology, and systematic biology.

The duration of research grants in this group ranges from 1 to 5 years, with an average length of 1.8 years. The average grant amounts to $9919 per year. The research grants were approved by the National Science Board upon the recommendation of Dr. Alan T. Waterman, director of the Foundation.

Let's Really Get Back to Fundamentals*

By H. I. TARPLEY

Professor of Electrical Engineering, The Pennsylvania State College

When teachers of engineering subjects assemble, sooner or later their talk will turn to curriculum building. This was never more evident than in the deliberations of local ASEE institutional committees appointed this year to study teaching techniques in their own colleges, and universities. Try as they might, committee members were never able to divorce their discussions on teaching techniques from curriculum revision.

Objectives of Engineering Training

Any discussion of technical options in electrical engineering undergraduate curricula must first consider objectives. Too often a local curriculum will be built around the interest of staff members with a lamentable disregard to the students' needs. What are the simple objectives in the training of any student engineer? They have been competently set forth in a statement by Warren K. Lewis, "Our objective is the development of the capacity of the student when faced with a new and unfamiliar situation, to handle it with competence involving skill, initiative and leadership. . . ."

A curriculum that succeeds in attaining the foregoing would be considered ideal by anybody, and must give a broad fundamental training to our engineering students.

Options in Engineering

Since fundamental physical principles and methods of engineering analysis in mechanical engineering, electrical eng neering, chemical engineering, civil eng neering, industrial engineering, aeronau ical engineering, etc. are identical, why these options? Most institutions set u all of these engineering options years ag solely in the interest of thoroughnes Some few colleges still feel that these a unnecessary, and accordingly have eli inated these options.

Options in Electrical Engineering

Why was it necessary to further sub divide each, for example, electrical eng neering into the technical options, Ele tronics, Communication, and Power? Th same principle that led to subdivision the engineering curriculum as a whole wa followed in setting up electrical enginee ing technical options. It was caused agai by the desire for thoroughness.

To raise the question as to how su cessful the system of options in electric engineering is at the present will caus an unending argument among the variou teachers. However, a few weaknesses wi be admitted by anybody. First, no ele trical engineering option is any bette than the sum total of the technical cours constituting that option. Therefore, th weaknesses of options are inherent in th various technical courses which have to often become "hardware" courses. Th rise of an electrical "gadget" to economi importance has been the signal for a ne "hardware" course to be crowded into on of the electrical engineering options as technical course. Often these are mor descriptive to the student than not, an offer little fundamental training that i

* Paper delivered at Annual Meeting of ASEE in East Lansing, Mich., June 25–29, 1951.

worthwhile in the long run. The carry-over of fundamental principles of analysis between these "hardware" courses is disheartening to behold. Each of these courses, even in the same option, often plough the same "ground" over and over in the hope that some few "grains" of common fundamental analysis will remain with the student. Some of the better students recognize and remark at the duplication of effort, while the average student is never aware that there is much relation between the various courses at all. That there is much truth in the foregoing observations is supported by the rapid increase of the number of colleges and universities that have found it necessary to insert into their electrical engineering curricula a course in engineering analysis in order to attempt a correlation of courses. Let nothing be said here to detract from a successful course in engineering analysis.

The use of "hardware" in a course should be only for the purpose of bringing to the fore the use of fundamental principles applied to a sample engineering problem.

The chief weakness of subdividing electrical engineering into the electronic, communication and power options lies in the fact that the division has been made solely on the basis of "hardware." The student is easily led to "glorify" the hardware of his special field; he cannot evaluate the true significance of any fundamental principles used because his focus is on the "hardware." He can only learn, in many instances, a few formulas that may be used in the solution of some few typical engineering problems.

Is it possible for a teacher of a technical option course to compensate for such weaknesses by a meticulous pointing out of fundamental analysis and principles as they are used? Of course good teaching techniques will help. On the other hand, the teacher cannot easily, by any teaching technique, take the student's focus from the "hardware" because of the restricted area with which an option deals. The student does not therefore, gain a broad background in fundamental principles as most options are organized.

Why have the engineering options, mechanical engineering, electrical engineering, civil engineering, etc. been relatively more successful when compared to the sub-options of the electrical engineering curriculum? The answer lies in the fact that the former options are *not* made on the basis of "hardware" alone, but on a more fundamental basis of principles. Whether engineering was divided consciously into options on the basis of fundamental principles is immaterial. The fact remains that electrical engineering has been subdivided consciously into options on the basis of "hardware."

The present option scheme in many electrical engineering curricula has equipped students with an inadequate narrow background, that has not fitted them to cope easily with the problems of engineering. There are many signs of this inadequacy. One of the most distressing is the difficulty of finding young instructors with a sufficiently broad background to teach the undergraduate stem courses. Many are indignant if asked to teach a laboratory stem course in power machinery when they are products of a communication option. Their training included such a diluted presentation of power machinery that they are incompetent to teach even the most elementary courses involving power machinery.

There are alternatives which can overcome some of the objections to the common existing technical option program.

Improved Option Programs

For those of us that feel the option program has merit, the most pressing need for improvement requires, first, as much liberalization of the choice of option technical courses as possible, coupled with a sincere attempt to organize those technical courses into broad fundamental courses that do not focus the attention of the student unduly on "hardware." It is unnecessary to attempt to analyze all the

principal "hardware" of a given field, since such analyses should serve only as examples.

Option programs ought to permit a student to select technical courses that are considered definitely "out of bounds" in many present option programs, in order to broaden his fundamental background. At once, the cry will go out that to permit a student some personal choice of technical courses contrary to an outlined option program would only destroy the option. The answer to that is obvious; if it would, the option program ought to be destroyed! Any student's choice of elective technical courses outside the prescribed option program may be safely guided by his adviser. The student would feel a personal responsibility for his program when he had cooperated with an adviser in its planning.

Conclusions

1. To give a more fundamental training to electrical engineers, option programs must be liberalized as much as possible to permit a choice of technical courses by the individual student. The fewer the number of prescribed technical courses in a given option, the better.

2. The professional technical course must use the "hardware" of a given field only as examples to which emphasized fundamental principles are applied.

Reserve this date . . . .

June 22-26, 1953

ANNUAL MEETING

UNIVERSITY OF FLORIDA

GAINESVILLE, FLORIDA

Science and Public Relations[1]

By JOHN I. MATTILL

Secretary, Engineering College Research Council; and Assistant Director, News Service, Massachusetts Institute of Technology

When the House of Representatives first cut 98% from the appropriation requested for the National Science Foundation for 1951–52, its members are said to have reasoned that the United States cannot afford the luxury of "unproductive" fundamental research at a time when practical results are so desperately needed by the Military.

Later this nonsense was repudiated; the cut in National Science Foundation funds was partially restored, to $3.5 million of the $14 million first wanted, by the Senate and House in conference. But the skirmish proved once more how little is known among laymen—even in high places—about the ways and needs of science. "Apparently the men and women of science and technology must undertake a broad program of educational research in Washington," said *Chemical and Engineering News*.[2]

Scientists have already cut their teeth in the business of persuading fellow citizens to their methods and achievements. The very existence of the National Science Foundation proves the success of one of the scientists' initial efforts and the form of today's Atomic Energy Commission is still more eloquent evidence.

Engineers, though they shared in setting the stage for the National Science Foundation, have made a lesser beginning in the job of telling laymen about their profession and its significance.

This is the job of public relations, including a multitude of activities whose goal is their single unifying common denominator. These activities share one other characteristic: all have special implications for *administration*, because responsibility for them begins there.

What public relations may mean to engineering research administrators was given brief attention before the Engineering College Research Council at East Lansing, Michigan, in June, 1951. If the four papers given there could only scratch the surface of a very broad subject, the summarizing which follows necessarily multiplies this inadequacy.

The story begins with an unusually effective informal definition of public relations by an outstanding professional counsel. It ends with a sharp warning from the director of one of the most effective public relations organizations in American science. In between is the more practical "how to" side of the story from two of its practitioners in leading engineering schools.[3]

[1] A summary of four papers presented before the ECRC in East Lansing, Michigan, June, 1951.

[2] Vol. 27, No. 38 (Sept. 17, 1951), p. 3789.

[3] Both were at the time members of the first National Publicity Committee of the American Society for Engineering Education, of which Richard W. Schmelzer of Rensselaer Polytechnic Institute was chairman. As a result of this group's work in publicizing the 1951 Annual Meeting, a Public Relations Committee has been established as a permanent function of the Society; Mr. Schmelzer continues as chairman.

What the Other Man Thinks of You

"Public relations began," said Allen Will Harris,[4] "when God or Charles Darwin created the first two persons on this earth. It became increasingly important when the third person was born. And it is not entirely a joke to suggest that the fourth person was a public relations expert, amateur or professional.

"What I am stating is simply that Man, Man's attitudes, Man's relations, Man's need for communication, are the basic business of public relations. The goals are equally simple: to help create a healthy, attractive personality, based on sound policies and real accomplishments, and to attract maximum favorable attention for that personality in order to increase its effectiveness.

"A shorter definition is this: public relations is anything you do that affects what another man thinks of you."

A definition in somewhat different form came from James W. Armsey,[5] who said, "Public relations means doing a good job and getting recognition for it. It means building a good reputation through good character. In any enterprise, and particularly in education, it means making sure that the public is served and that it knows it is served."

The breadth of public reltaions by these definitions suggests that some of its aspects have a way of turning up in almost every executive act.

"Since policies flow from top management and activities result from policies," Mr. Harris continued, "the major responsibility for public relations cannot be delegated 'down the line.' Sound public relations requires top management to put the factor of what-the-other-man-thinks into each equation confronting it. The weight accorded to the factor will vary with the nature of the problem, but th factor must always be included in dec sion-making."

To many engineering research admin istrators this may seem the addition of new and very foreign dimension to thei problems. But in another sense, publi relations is only a formal expression o much that is in the realm of "commo sense" to every good administrator. Thu Mr. Harris went on, "Public relations is *total* activity, touching upon all phases o the organization's life, from personne recruitment to morale, turnover, pay, jo security, patents, legal activities, com munity relations, guests, contract-getting and contract-keeping, relations with Gov ernment, public information, security, con tacts with the professional societies, an so on, endlessly. Secondly, public rela tions has a passion for facts, the sub jective facts of opinion and attitude Thirdly, public relations seeks to remedy what is wrong, prevent further conflicts o failures, and encourage the healthy an effective portions."

"The essence of public relations i knowing the importance of what the othe man thinks and feels," said Mr. Harris taking pains to emphasize both the breadth and subtlety of the problems thus im plied.

"Since many of you make the decisions which underlie your organizations' public relations, let me briefly suggest what might be called the public relations process fo reaching a decision:

1. Determine accurately the objective of the decision.
2. Determine in detail all of the routes to these objectives.
3. Determine the needs and attitudes of the person or groups necessary to the success of the decision.
4. Determine which of the routes to your objectives will fulfill the largest number of needs and cross the smallest number of attitude obstacles.
5. If the obstacles seem grave or even insurmountable, honestly and care

[4] Public Relations Counsel, 229 West 42nd Street, New York 18, New York.

[5] Then Director of Public Relations, Armour Research Foundation and Illinois Institute of Technology, Chicago 16, Illinois; now Assistant to the President, New York University, New York 53, New York.

fully consider the possibility of changing your objectives.

6. If the objectives are the only possible objectives and if no new route is practicable, be sure to state the full reasons for your decision clearly when you communicate it. Most persons will put aside their opinions and try to make your ideas work if you give them the full, frank and honest facts.
7. No matter how small the decision may be, accept as a major premise of your administration that the decision *must* be sold and *resold* and the consequences of the decision subjected to periodic evaluation.

"These steps, modified and adjusted to the specific case, as all general systems must be, can do an amazing amount toward the elimination of old problems and the aborting of new problems. This is a practical approach, well tested and proven in a host of organizations of the first rank.

"The choice facing you is not a choice between public relations and no public relations, but between deliberate, organized public relations and accidental public relations. You need not worry about the cost of organized public relations; the cost is almost always smaller than that of an accidental, unorganized activity."

Policy-Making in Public Relations

Mr. Armsey carried these concepts to the more specific questions facing college and university research administrators. Research, he said, adds a complication to the traditional responsibilities of educators to students, parents, teachers, and the public from which (directly or indirectly) comes their support. Through its effect on all these, research adds a new complication, too, to public relations.

Research affects the budget, forcing adjustments of costs and salaries. It affects personnel—including factors of availability, qualifications, personal interests and desires, and personnel management methods. The main responsibility of an educational institution is to students, and research can affect their college experience. A fourth set of problems arise in connection with public service responsibilities: local research needs of industry may not be entirely consistent with the best interests of an educational program. "One of the pesky things that cuts across the lines of responsibility to your students, the public, and yourself is the general problem of classification and publication," added Mr. Armsey.

"All of these questions are part of the total policy-making aspect of your public relations program. I have purposely stressed them because the effectiveness of the other two aspects of public relations are dependent upon what answers you arrive at. That is, you can't hope a) to do a good job, or b) to get credit for it, unless by your policy decisions you create an atmosphere in which a good job can be done.

"Your first big public relations problem is to realize you have a public relations problem. That's not easy. Your contract research, like your teaching, or like any other activity in today's society, cannot be done in a vacuum. It is subject always to critical scrutiny by several publics, or segments of the so-called general public. And education, despite its wide acceptance as a worthwhile enterprise, finds its critics numerous and vocal."

"The truth is," Mr. Harris had earlier said, "that research organizations, indeed all scientific organizations and technical groups present some of the most difficult problems to be found in the public relations field." He listed four worthy of special consideration:

1. Security regulations prohibit normal communications among scientists, between organizations and their communities, and between science and the lay public.
2. The time scale of major research is dangerously misunderstood; the public is being led to a terrible disil-

lusionment because of the gap between what can be done and what self-promoters claim for scientific endeavor.

3. Increasing amounts of research are dedicated to developing materials of destruction; will a revulsion from war presently stigmatize scientists as "merchants of death?"
4. No species is more difficult to organize and manage than the modern scientist.

Policies and Procedures

All of these problems, said Dr. Lisle A. Rose,[6] raise fundamental questions of setting up and conducting a public relations program for our research activities. Why a *program?*

"The answer is plain and simple: to aid in doing effectively and economically what all of us do every day whether we know it or not, like it or not—that is, give information to a large number and variety of people and leave impressions of our worth with them.

"Since we are necessarily engaged in public relations, it seems prudent to engage intelligently—with foresight, with coordination, without stumbling and fumbling and waste. It seems prudent to get the most possible benefit for ourselves and give the most possible benefit to our publics with the smallest feasible cost in effort and money. This means planning. It means a program."

The kind of program depends on many factors, Dr. Rose said. Many have been mentioned already; in addition, he listed the number and nature of an organization's audiences, its sponsoring and cooperating agencies, policies established by outside and inside agencies . . . all must be fitted into the overall concept guiding the character of public relations.

These research and public relations policies must vary from institution to institution. But, according to Dr. Rose, "four obvious Policies about Policies ought to be universal. First, policies governing research and public relations ought to be rational in view of *all the circumstances* in which the administrators, the research men, and the participants in the public relations program find themselves situated. Second, everybody should understand the what and why of the policies. This is one function of any public relations specialist whom the research organization may utilize. Third, the policies ought to be reviewed frequently—with account taken of such intangibles as tradition and even to some extent personal desires and preferences. Last, policies that don't stand up under review should of course be modified or replaced."

What about the public relations specialist? He soon becomes an important part of this story, Mr. Armsey had earlier noted. "Once you have recognized that you have public relations whether you like it or not, and you have decided that you should actively operate to make your public relations good, your next step is to get a good public relations director, or, if you already have one, to utilize his talents to the fullest.

"His biggest value to you is his advice and counsel in helping you steer a sound administrative course that will result in getting a good job done and in getting you proper recognition for doing it. He can do his job best if you keep him informed, consult him often, and work cooperatively with him."

For the director and his public relations staff, the rub comes with specific problems. "We don't always do and say the right things," Dr. Rose admitted. "But we must try to anticipate the occurrence of problems, not find ourselves suddenly stuck with them. We must bring in on our decisions the judgment of a number of men, not just the supervisor of a research project or the Director of Public Relations or the Director of Research. And to guide our decisions, I repeat, we must have well-defined policies

[6] Director of Information and Publications and Experiment Station Editor, College of Engineering, University of Illinois, Urbana.

based on well-defined purposes and on continuous analyses of our publics."

This kind of public relations program, Dr. Rose said, is eminently justified—and in fact necessary—for an institution supported mainly by taxes. "People will not long pay for something whose worth they do not believe in. For expediency's sake, then, if nothing else, the value of research and its relative inexpensiveness ought to be set forth." The same argument applies, with only slight variations, to privately financed institutions.

But, continued Dr. Rose, there is a higher, less selfish reason as well. "None of us carry wings; but we all try to fill a beneficial social function. Most of us try to give more service than we're paid for. So we ought to volunteer certain kinds of information and translate other kinds voluntarily into common terms that the layman grasps."

Public Relations is a Vital Obligation

The results of present-day public relations activities for and by science are promising, said Dr. Walter J. Murphy.[7] "We believe," he said, "that science has been sold quite well to the American public—a development for which we of the American Chemical Society News Service take some credit. But we do not think our task has been completed."

"Science today is intimately interwoven into the fabric of everyday living," Dr. Murphy pointed out. Research has resulted in many grave problems which now have become the subject of public discussion, and the progress of science is dependent upon political decisions which rest ultimately with the public. "It now becomes our duty and responsibility to see that the American people are properly educated on the scientific aspects so that decisions they do make are sound," he said.

"We now have a National Science Foundation. We have the problem of finding continued financial support from private sources for fundamental research and for our institutions of learning so that the overall support will not be entirely governmental in nature. We have the grave problem of the proper utilization of our scarce scientific and technical manpower in a period of international uncertainty. We have the problem of encouraging more of our youth to enter the learned professions, particularly the physical sciences and engineering. We have a great problem of educating the American public to the fact that we can no longer depend upon foreign sources for much of our pure and fundamental research.

"How this country meets these and other equally great questions over the next decade will mean the difference between a democratic or totalitarian life for hundreds of millions. The future of America is wrapped up in many of these questions. Today when I talk to you about public relations, it is these questions that are uppermost in my mind. These are the challenges that we must meet; these are the responsibilities that we have created for ourselves. Frankly, I must admit at this particular moment, we are poorly equipped to cope with our obligations.

"Call me an alarmist if you will, but I warn the scientific, technical, and professional societies of America that, unless they undertake immediately a broad program of education concerning science and technology and their implications to the man on the street, disastrous decisions will be made by the citizens of this country on matters of life and death importance. Democratic processes function properly only when the electorate is fully informed on the questions they are asked—yes, required to decide. This is a responsibility and an obligation that we of the learned professions cannot disregard."

[7] Director of the American Chemical Society News Service and Editor of *Chemical and Engineering News* and *Industrial and Engineering Chemistry*, 1155 16th Street, N.W., Washington 6, D. C.

TIMELY TIPS

A Note on the Validity of the Pre-Engineering Ability Test

By ROLAND C. MOORE

Head, Bureau of Measurement and Guidance, Carnegie Institute of Technology

The Pre-Engineering Ability Test (2) was offered in 1951 as a "short, inexpensive, easily administered and readily scored test" providing "a predictive effectiveness estimated to be . . . as high as that for the composite score on the Pre-Engineering Inventory." The present note deals with the extent to which this estimate of validity has been confirmed in a situation of actual use of the test.

The Pre-Engineering Ability Test was administered to all freshmen entering the College of Engineering and Science at the Carnegie Institute of Technology in September 1951 during the initial week of the term. At the close of the semester the correlation was calculated between total scores on the Pre-Engineering Ability Test,* and student "factors" (weighted averages of course grades) earned for the first semester work. The correlation sample consisted of 260 students, after exclusion of those who did not complete a semester's work, those with previous college work, and those with foreign language handicap. The correlation coefficient resulting was .68. This value stands up well in comparison with validities of the Pre-Engineering Inventory Composite Score for first term average grades as reported for various schools (1) and is not lower than correlations obtained at this institution in previous years between the PEI Composite Score and "factor" at the same point.

A further comparison is possible in that Pre-Engineering Inventory Composite Scores were also available on 57 of the students in the present sample. For this group, characterized by PEA Total Score mean and standard deviation quite similar to those of the parent sample, the correlation between PEI Composite Score and factor was .75, and that between PEA Total Score and factor was .73. Here, of course the absolute magnitude of the coefficients is of less significance than their close correspondence.

These findings thus support the view that the objectives of providing a shorter, more convenient test without sacrificing the predictive power of the longer test have been attained, and that no less confidence accrues to the PEA Total Score than to the PEI Composite Score in situations appropriate to the use of the PEI Composite Score.

* PEA Total Score Mean is 50.5, and standard deviation 13.07. All correlations given are significant beyond .01.

REFERENCES

1. Lord, F., Cowles, J., and Cynamon, I. "The Pre-Engineering Inventory as a Predictor of Success in Engineering Colleges." *J. App. Psychol.*, *34*, pp. 30–39 (1950).
2. *Manual, Pre-Engineering Ability Test*. Educational Testing Service, Princeton, N. J. (1951).

A Double Integral

A Visual Presentation

By E. A. WHITMAN

Associate Professor of Mathematics, Carnegie Institute of Technology

The slide film, "A Double Integral," was prepared for classroom use. The captions are intended to give the required explanations though the author prefers to accompany the slide film with his own comments, the latter being adjusted to the needs of his particular class in calculus. No accompanying recording has been made as it would appear likely that this slide film, and the others with which it forms a set of films on integration, would be used largely by instructors who would desire to make their own comments. As the teaching of calculus falls more and more into the hands of inexperienced instructors it may become desirable to use recordings.

It is assumed that the reader is interested in the *whys* and *hows* of slide films such as this rather than in the subject matter presented. Each frame is a photographic representation of a drawing by the author. These drawings, the captions and the accompanying equations, yes, even many of the numbers and separate letters were made separately and pasted on a sheet. This is a great advantage over trying to put everything on one sheet and gives a chance to arrange and rearrange to improve composition. Generally the drawings project better if the photographer prepares negative slides, thus having the words and lines appear in white on a black background.

Slide Film Supplements Text Book

In the subject of integration, the slide film is of particular use as a supplement to the text book. Many drawings are needed, too many to be included in a text-book. Each figure serves a limited purpose, yet a definite one in showing how an element of an area is changed as certain changes are made in an arbitrarily chosen length. There is not one big or complicated drawing that can show the whole mass of details since some blot out others.

This need for many drawings in the story of integration is in contrast to a complicated figure of a machine—say perhaps some drawing with which an instructor is experimenting preparatory to inclusion in a text book. Yet with such a drawing it might be well to consider a slide film in place of a single drawing, with each frame prepared to show an added detail. Successive pictures at various stages of the construction of such a building as a new summer camp tell more about the work of making such a building than does a picture of the finished product.

On this slide film the need for successive drawings really begins as we consider the column formed by adding several small elements of area, each a rectangle, one above the other. The calculus may require that one take the limit of the sum of the equal rectangles as the altitude becomes smaller and smaller but the number of rectangles is increased. A word description is difficult yet a set of some six to ten figures shows why it is that the limit of the columns is one definite column for a particular area no matter by what law we decrease the altitudes. The usual rectangle and column of a text book presentation leaves many students without any idea of the process. This process of summation must, in double integration, be repeated on the columns to cover the area. The essence of this slide film lies in showing, by a set of drawings, how an area bounded by curved lines is the limit of the summation of a set of rectangles. On

seeing this, the finding of that area is not merely a routine application of a formula out of a book.

This particular slide film has some added frames, for a second presentation to a class, showing limitations on the process, and modifications for particular circumstances. While these latter can be shown very well by black board figures the film gives the opportunity to use figures drawn at leisure.

While this film has been published a glance at the catalogue in which it is listed shows how very meager is the offering in slide films for subjects at the college level. It has been the experience of this author that publishers are quite willing to take considerable risks in publishing. What seems to be needed is teachers who are willing to prepare the necessary drawings and captions. At present the demand, at the college level, is not such as to give prospective authors much hope for monetary rewards. But the growth of that demand is in our hands.

College Notes

In preparation for completion of **Howard University's** new School of Engineering and Architecture building and facilities before September, 1952, the largest piece of new equipment, a new Baldwin testing machine of 600,000 lb. capacity was installed. This is part of a $2,000,000 expansion program of the School of Engineering and Architecture.

Section Meetings

Section	*Location of Meeting*	*Dates*	*Chairman of Section*
Allegheny	Pennsylvania State College	April 18–19, 1952	E. B. Stavely, Pennsylvania State College
Illinois-Indiana	University of Illinois	May 17, 1952	D. G. Ryan, University of Illinois
Kansas-Nebraska	University of Nebraska	Nov. 16–17, 1951	Kenneth Rose, University of Kansas
Michigan	University of Detroit	May 10, 1952	W. P. Godfrey, University of Detroit
Middle Atlantic	Villanova College	May 10, 1952	S. J. Tracy, Jr., City College of New York
Missouri	University of Arkansas	April 5, 1952	R. Z. Williams, Missouri School of Mines
National Capital Area	Howard University George Washington University	February 5, 1952	W. Oncken, Jr., Bureau of Ordnance
New England	Worcester Polytechnic Institute	Oct. 18, 1952	E. T. Donovan, University of New Hampshire
North Midwest	Iowa State College	Oct. 3–4, 1952	S. J. Chamberlin, Iowa State College
*Ohio	Ohio State University		W. F. Brown, University of Toledo
Pacific Northwest	University of Washington	April 25–26, 1952	T. H. Campbell, University of Washington
Pacific Southwest	California State Polytechnic College	Dec. 29–30, 1952	S. F. Duncan, University of Southern California
Rocky Mountain	University of Wyoming	April 19, 1952	E. J. Lindahl, University of Wyoming
Southeastern	Clemson College	April 10, 11, 12, 1952	R. L. Sumwalt, University of South Carolina
Southwestern	University of New Mexico	April 3 & 4, 1953	H. P. Adams, Oklahoma A. & M. College
Upper New York	Alfred University	October 10–11, 1952	R. M. Campbell, Alfred University

Members of the Society are welcome at all Section Meetings

* No Date Set.

New Members

ADEMINO, JAMES N., Instructor in Chemical Engineering, Villanova College, Villanova, Pa. J. B. Conway, J. S. Morehouse.

AIDLIN, SAMUEL S., Director, KC Chapter, NYSSPE, Brooklyn, N. Y. S. J. Tracy, E. Hausmann.

ANDERSON, CHARLES R., Instructor in Mechanical Engineering, Pratt Institute, Brooklyn, N. Y. A. W. Luce, K. E. Quier.

BALL, HERBERT J., Professor of Textile Engineering, Lowell Textile Institute, Lowell, Mass. M. Hindle, M. E. Gelinas.

Bankoff, S. George, Associate Professor of Chemical Engineering, Rose Polytechnic Institute, Terre Haute, Ind. C. E. Kircher, Jr., E. A. MacSean.

BLEICH, HANS H., Associate Professor of Civil Engineering, Columbia University, New York, N. Y. W. J. Krefeld, J. M. Garrelts.

BOLT, RICHARD H., Director, Acoustics Laboratory, Massachusetts Institute of Technology, Cambridge, Mass. A. B. Bronwell, S. C. Hollister.

BROOKER, DONALD B., Assistant Professor of Agricultural Engineering, University of Missouri, Columbia, Mo. M. M. Jones, K. J. Farquharson.

BURR, ARTHUR A., Associate Professor of Metallurgical Engineering, Rensselaer Polytechnic Institute, Troy, N. Y. A. A. K. Booth, P. E. Hemke.

CAMPBELL, WALTER M., Director, Extension Division, University of Colorado, Boulder, Colo. C. L. Eikel, K. D. Wood.

CANNON, WALTON W., Associate Professor of Electrical Engineering, University of Arkansas, Fayetteville, Ark. W. B. Stiles, N. H. Barnette.

CHAMEIDES, MAXIMILIAN, Lecturer in Electrical Engineering, City College of New York, New York, N. Y. V. Deltoro, G. J. Clemens.

CLAFFEY, PAUL J., Assistant Professor of Civil Engineering, Catholic University of America, Washington, D. C. F. Biberstein, J. S. Mendousse.

COCKSHOTT, ALFRED H., Assistant Professor of Mathematics, Manhattan College, New York, N. Y. A. Leo, F. Aubert.

CONVERS, FREDERICK L., Instructor in Petroleum Engineering, University of Pittsburgh, Pittsburgh, Pa. H. F. Botset, N. L. Buck.

COTTER, JOHN B., Associate Professor of Mechanical Engineering, Catholic University of America, Washington, D. C. J. L. Lackler, J. C. Michalowic.

CRATER, WARREN H., Assistant Professor of English, Newark College of Engineering, Newark, N. J. H. A. Estrin, J. H. Pitman.

DAUS, PAUL H., Professor of Mathematics, University of California, Los Angeles, Calif. S. C. Hollister, A. B. Bronwell.

DAY, CECIL L., Assistant Professor of Agricultural Engineering, University of Missouri, Columbia, Mo. M. Bolstad, K. J. Farquharson.

DEAN, DONALD L., Instructor in Civil Engineering, Missouri School of Mines, Rolla, Mo. C. L. Wilson, J. M. Brewer.

ELLER, ARTHUR L., Instructor in Engineering, Los Angeles City College, Los Angeles, Calif. J. B. Franzini, B. W. Martin.

ELLIOTT, GEORGE W., Assistant Professor of Mechanical Engineering, University of Missouri, Columbia, Mo. R. Scorah, M. Bolstad.

EVANS, CLARENCE H., Supervisor of Chem. Eng. Consultants, Engineering Dept., E. I. duPont de Nemours & Co., Wilmington, Del. M. J. Bergen, M. Burke, Jr., Fluck. Paul G., Assistant Professor of Mechanics, University of Wisconsin, Madison, Wis. R. R. Worsencroft, H. D. Orth.

GAWAIN, THEODORE H., Associate Professor of Aeronautics, U. S. Naval Postgraduate School, Monterey, Calif. F. G. LaCaus. G. J. Higgins.

GILL, JOHN D., Instructor in Mechanical Engineering, University of Miami, Miami, Fla. W. Hubbell, J. H. Clouse.

GRYGOTIS, CASEY, Head, Mathematics and Engineering, Union Jr. College, Elizabeth, N. J. S. C. Hollister, A. B. Bronwell.

HARP, HUGH G., Associate Professor of Mathematics, Ohio Northern University, Ada, Ohio. L. H. Archer, J. A. Wein**hampel.**

HAUBNER, ROBERT K., Instructor in Mathematics, Newark College of Engineering, Newark, N. J. H. Barkan, P. Mainardi.

HEERMANN, GEORGE A., Associate Professor of Chemistry, Marquette University, Milwaukee, Wis. J. E. Matar, W. D. Bliss.

HIPPE, ROBERT W., Instructor in Physics, Parks College of Aeronautical Technology, East St. Louis, Ill. R. A. Killoren, H. R. Grummann.

HOUPIS, CONSTANTINE H., Assistant Professor of Electrical Engineering, USAF Institute of Technology, Dayton, Ohio. E. A. Szymanski, E. L. Fairchild.

HOWE, STEWART S., Vice President, Illinois Institute of Technology, Chicago, Ill. B. A. Fisher, A. B. Bronwell.

HOWERTON, MURLIN T., Assistant Professor of Chemical Engineering, University of Notre Dame, Notre Dame, Ind. R. E. Rich, E. J. Wilhelm.

HOWETT, MICHAEL V., Instructor in Physics and Mathematics, Schreiner Institute, Kerrville, Texas. T. M. Hammond, H. W. Crate.

JACKSON, ARTHUR, Professor of Engineering Drawing, Queen's University, Kingston, Ont., Canada. J. S. Rising, A. S. Gaskell.

JENKINS, JEAN A., Director, Placement Service, Texas Technological College, Lubbock, Texas. D. E. Holcomb, C. C. Perryman.

KNUDSEN, A. RUSSELL, Instructor in Mathematics, Valparaiso Technical Institute, Valparaiso, Ind. J. B. Hershman, O. M. Knudsen.

KULHAN, EDWARD F., Instructor in Civil Engineering, Pennsylvania State College, State College, Pa. L. Perez, B. A. Whisler.

LAZARUS, IRWIN P., Instructor in Industrial Engineering, Purdue University, Lafayette, Ind. S. Fairman, W. B. Sanders.

LYDON, MARTIN J., President, Lowell Textile Institute, Lowell, Mass. A. E. Wells, M. Hindle.

MARTIN, HAROLD W., Associate Professor of Management, Rensselaer Polytechnic Institute, Troy, N. Y. A. A. K. Booth, P. E. Hemke.

MARTINUZZI, PIO F., Professor of Mechanical Engineering, Stevens Institute of Technology, Hoboken, N. J. K. J. Moser, R. O. Vuilleumier.

MCGOWAN, FRANK K., Engineering Department, Union Junior College, Elizabeth, N. J. A. B. Bronwell, S. C. Hollister.

MCKIBBEN, EUGENE G., Director of Agricultural Engineering Research, U. S. Dept. of Agriculture, Hyattsville, Md. J. D. Long, V. T. Morris.

MCLERRAN, JAMES H., Acting Junior Engineer, The State College of Washington, Pullman, Wash. E. G. Ericson, C. L. Barker.

MCNAMEE, MAURICE B., Associate Professor of English, St. Louis University, St. Louis, Mo. V. J. Blum, O. W. Nuttli.

MINTZER, OLIN W., Assistant Professor of Highway, Purdue University, Lafayette, Ind. K. B. Woods, R. B. Wiley.

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